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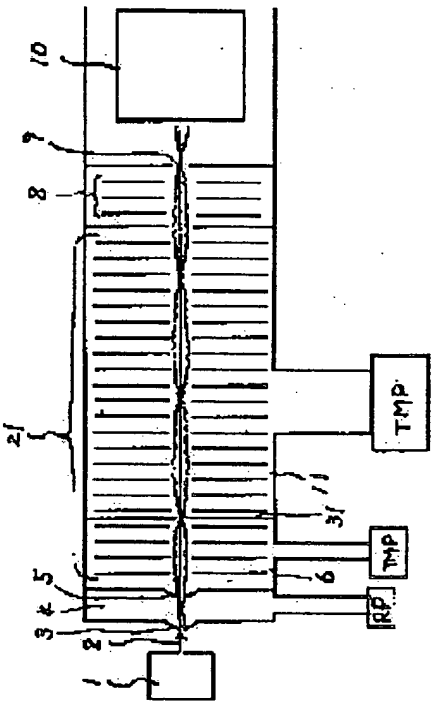
(54) ATMOSPHERIC PRESSURE IONIZATION MASS SPECTROGRAPH

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an atmospheric pressure ionization mass spectrograph capable of guiding the ions generated by an atmospheric pressure ion source and introduced into an intermediate exhaust chamber via a guide port into a mass spectrometry section with high passing efficiency over a wide mass range.
SOLUTION: This atmospheric pressure ionization mass spectrograph ionizes a sample in the atmospheric pressure or the pressure atmosphere near it and guides the ions to a mass spectrometry section arranged in vacuum via a guide port for mass spectrometry. The mass spectrograph is provided with ion guides 21 guiding the ions introduced via the guide port to the mass spectrometry section, arranged with plate-like electrodes having many ion passing ports in a line, and applied with voltages different in polarity in turn to the electrodes and barrier ribs 31 partitioning the chamber arranged with the mass spectrometry section and a chamber guided with ions via the guide port between the electrodes of the ion guides 21.



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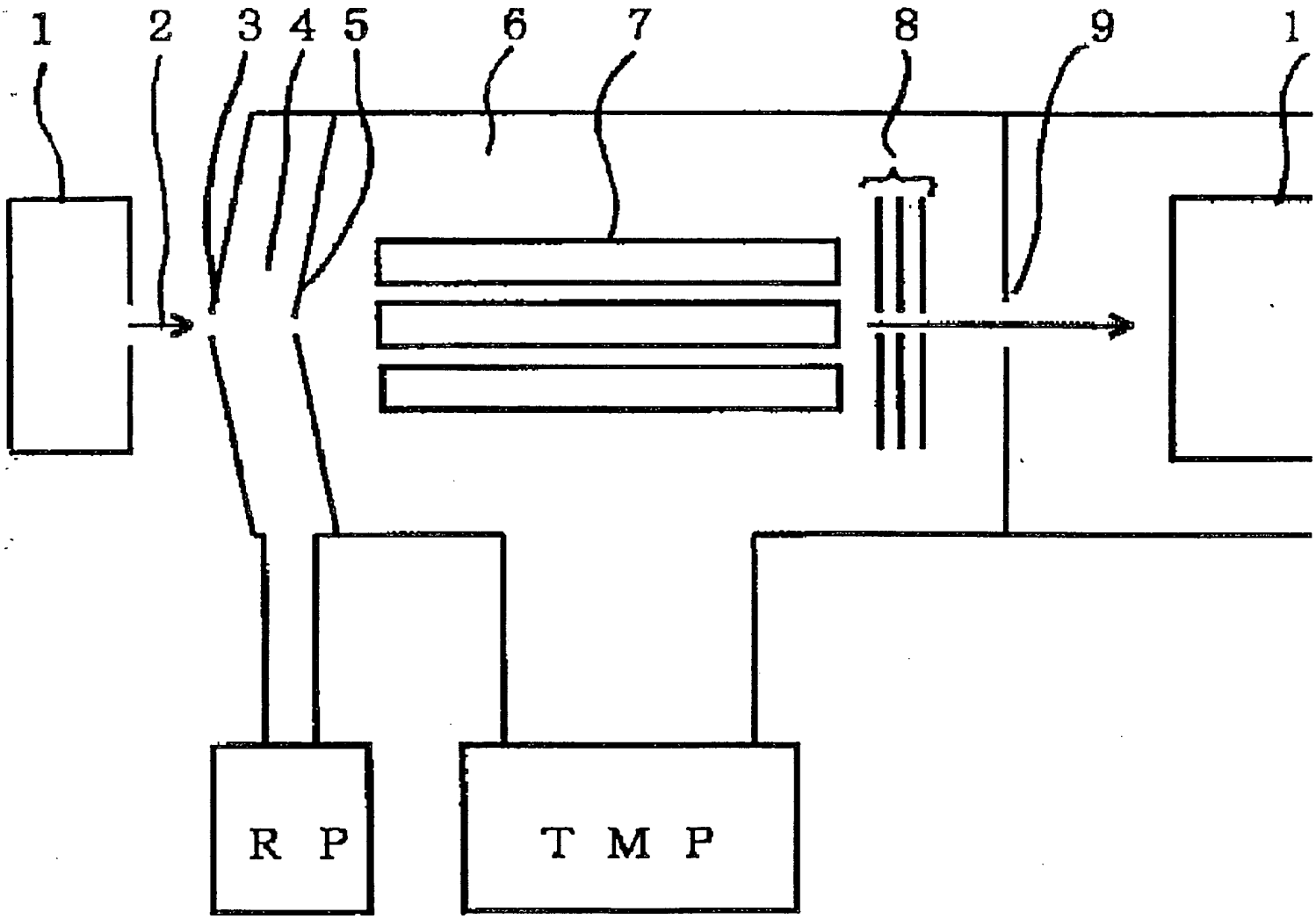
DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention ionizes a sample in atmospheric pressure or the pressure ambient atmosphere of the near, and relates to the ion guide which leads the ion especially introduced through the introductory opening to the aforementioned mass-analysis section about the atmospheric-pressure-ionization-mass-spectrometry equipment which introduces and carries out a mass analysis through the introductory opening to the mass-analysis section arranged in a vacuum.
[0002]
[Description of the Prior Art] The atmospheric-pressure-ionization method has spread widely from that handling is easy, it being soft ionization, etc. In the typical thing of an atmospheric-pressure-ionization method, it is APCI (atmospheric pressure chemical ionization). A method and ESI (electrospray ionization) There is a method etc. In order to introduce the ion generated by these ionizing methods to the mass-analysis section maintained by the high vacuum, a differential-pumping system is used.
[0003] Drawing 1 is drawing showing the iontophoresis section of the mass spectroscope equipped with such a differential-pumping system. In drawing 1 , the ion 2 generated by the atmospheric pressure ion source 1 is introduced through a skimmer 3 to the 1st interval exhaust room 4, and is further introduced through a skimmer 5 to the 2nd interval exhaust room 6. The multipole lens 7 and the convergent lens 8 for improving the convergency of ion are arranged, and the mass analysis of the ion with which convergency has been improved with these lenses is introduced and carried out to the 2nd interval exhaust room 6 to the mass-analysis section 10 maintained by the high vacuum (pressure of about 10 to 6 Torrs) through the introductory opening 9.
[0004] The aforementioned 1st interval exhaust room 4 is exhausted by rotary-pump RP by the pressure about 1 - number Torr, and the 2nd interval exhaust room 6 is exhausted by the pressure of about 1x10 to 3 Torrs by turbo-molecular-pump TMP, and constitutes a differential-pumping system by which the pressure differential between the ion source 1 of atmospheric pressure and the mass-analysis section 10 of a high vacuum is maintained.
[0005]
[Problem(s) to be Solved by the Invention] Only high-frequency voltage is impressed to Q pole lens which is prepared in order that the above-mentioned multipole lens 7 may prevent a diffusion of the ion in the 2nd interval exhaust room 6, for example, has arranged four cylindrical electrodes around an ion path at 90-degree regular intervals. 6 or eight cylindrical electrodes may be used.
[0006] However, a multipole lens has a VCF operation and the ion from which a mass to charge ratio is different cannot be passed at once over a large domain. In order to correspond to a large domain, it is required to carry out the sweep of the amplitude or frequency of high-frequency voltage, structure becomes complicated, and becomes disadvantageous and this is disadvantageous also in respect of photographic sensitivity.
[0007] this invention aims at offering the atmospheric-pressure-ionization-mass-spectrometry equipment which can cross the ion which was made in view of the point mentioned above, was generated by the atmospheric pressure ion source, and was introduced into the interval exhaust room through the introductory opening to a large mass domain, and can lead it to the mass-analysis section

at high transit luminous efficacy.
[0008]
[Means for Solving the Problem] In order to attain this purpose, the atmospheric-pressure-ionization-mass-spectrometry equipment of this invention In the atmospheric-pressure-ionization-mass-spectrometry equipment which introduces and carries out a mass analysis through the introductory opening to the mass-analysis section which ionizes a sample in atmospheric pressure or the pressure ambient atmosphere of the near, and has been arranged in a vacuum It is the ion guide which leads the ion introduced through the introductory opening to the aforementioned mass-analysis section. The ion guide which impressed the voltage from which many tabular electrodes which have the ion transit opening are arranged in 1 in all train, and a polarity is [electrodes] different in the transit opening by turns in each electrode is prepared. It is characterized by preparing the septum which divides the cella where the mass-analysis section is arranged, and the cella where ion is introduced through the introductory opening between the electrodes in the middle of this ion guide.
[0009]
[Embodiments of the Invention] Hereafter, with reference to a drawing, the gestalt of operation of this invention is explained in full detail. Drawing 2 is drawing showing the structure of one example of this invention. In drawing 2 , the ion 2 generated by the atmospheric pressure ion source 1 is introduced through a skimmer 3 to the 1st interval exhaust room 4, and is further introduced [in the 2nd interval exhaust room 6] through a skimmer 5 to the 3rd interval exhaust room 11. It is completed by the convergent lens 8 towards the introductory opening 9, the introductory opening 9 is passed, and the ion which the ion guide which reaches 2nd interval exhaust room 6 and is constituted from a ring lens 21 by the 3rd interval exhaust room 11 in this type over both is arranged, and was drawn by this ion guide is a high vacuum (pressure of about 10 to 6 Torrs). A mass analysis is introduced and carried out to the maintained mass-analysis section 10.
[0010] The above-mentioned ring lens 21 has the structure which made the transit opening consistent for the ring electrodes L1, L2, and L3 and ... which have the circular ion transit opening, and was arranged in the single tier at the fixed spacing, as shown in drawing 3 . The right voltage (+V) and the negative voltage (-V) are impressed to each electrode by turns every other sheet. The dashboard 31 (grounding potential) into which the aforementioned 2nd interval exhaust room 6 and the 3rd interval exhaust room 7 are divided is arranged so that it may have the ion transit opening of a ring electrode and this core and the equipotential surface of the middle potential zero of an adjacent ring electrode may be met.
[0011] Drawing 4 shows the potential distribution formed in the periphery of a dashboard 31 and the ring electrode of the neighborhood, and it turns out that it is arranged so that the equipotential surface of the middle potential zero of the ring electrode which a dashboard 31 adjoins may be met. The ion which carried out incidence to the ring lens 21 performs simple harmonic motion along with a central orbit by the electric field formed in a ring electrode, and passes a ring lens in the type guided to a ring lens.
[0012] The path of the ion transit opening prepared in the aforementioned dashboard 31 is the parvus from the ion transit opening of a ring electrode, although selected by the size required in order to maintain the pressure differential between the 2nd interval exhaust room 6 and the 3rd interval exhaust room 7. Then, the amplitude of the ion trajectory led to the 2nd interval exhaust room 6 through the skimmer 5 is arranged in the position near the minimum or it as the dashboard 31 is shown in drawing 2 .
[0013] therefore -- even if, as for ion, the dashboard 31 for a differential pumping is formed -- the ion transit opening of a dashboard 31 -- a loss -- it can pass few
[0014] As for a dashboard 31, it is desirable to set it as the optimum position with consideration to the mean free path and ion transit luminous efficacy (for the position with the amplitude of an ion trajectory near the minimum or it to be high) of the flowing ion according to an orbital calculation result. In addition, as a convergent lens 8, a ********** lens can be begun and various electrostatic lenses can be used.
[0015]
[Effect of the Invention] As explained in full detail above, the ion guide which impressed the voltage from which many tabular electrodes which have the ion transit opening are arranged in 1 in all train,

and a polarity is [electrodes] different in the transit opening by turns in each electrode in this invention is prepared. Since the septum which divides the cella where the mass-analysis section is arranged, and the cella where ion is introduced through the introductory opening between the electrodes in the middle of this ion guide was prepared, The atmospheric-pressure-ionization-mass-spectrometry equipment which can cross the ion which was generated by the atmospheric pressure ion source and introduced into the interval exhaust room through the introductory opening to a large mass domain, and can lead it to the mass-analysis section at high transit luminous efficacy is offered.

[Translation done.]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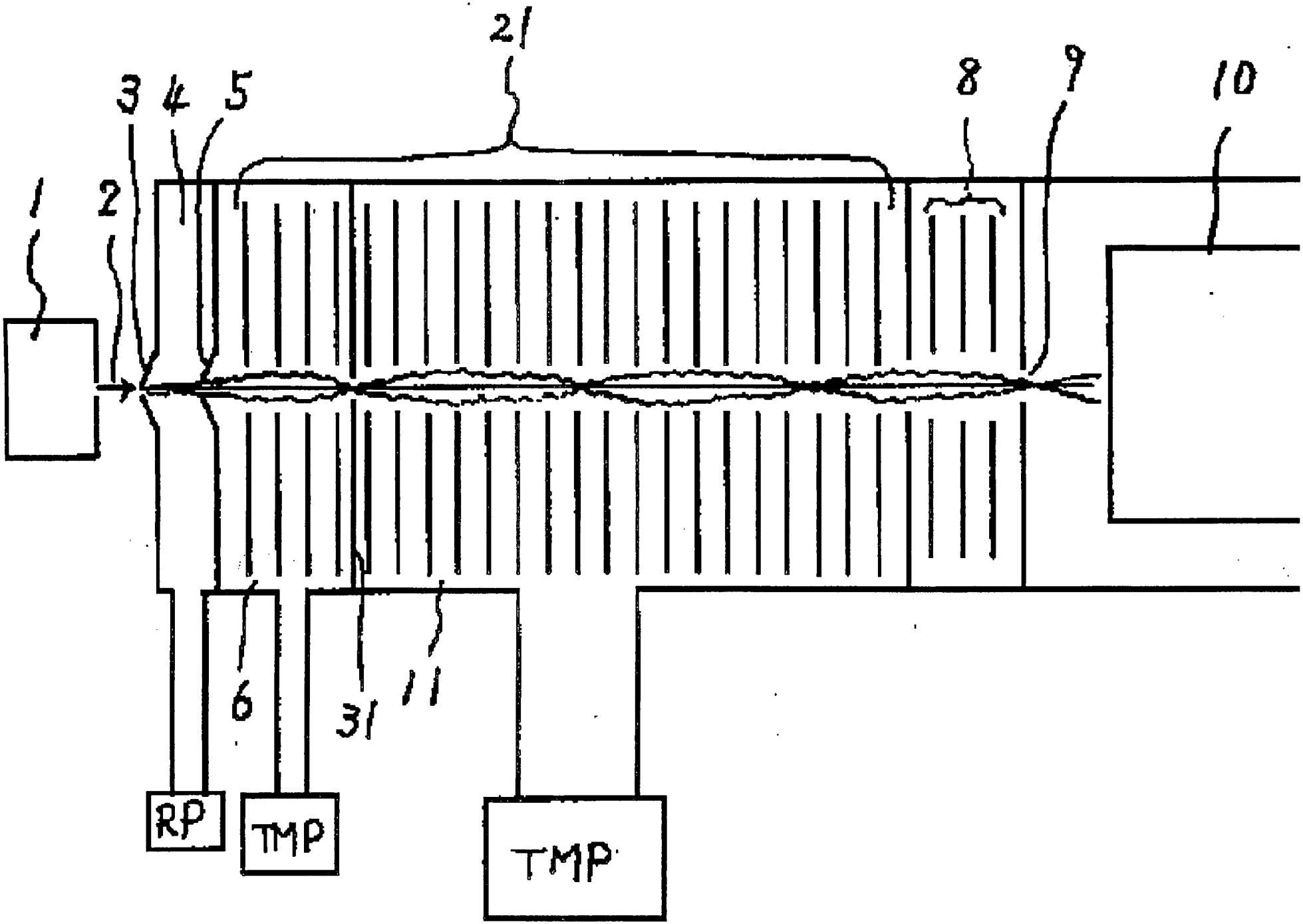
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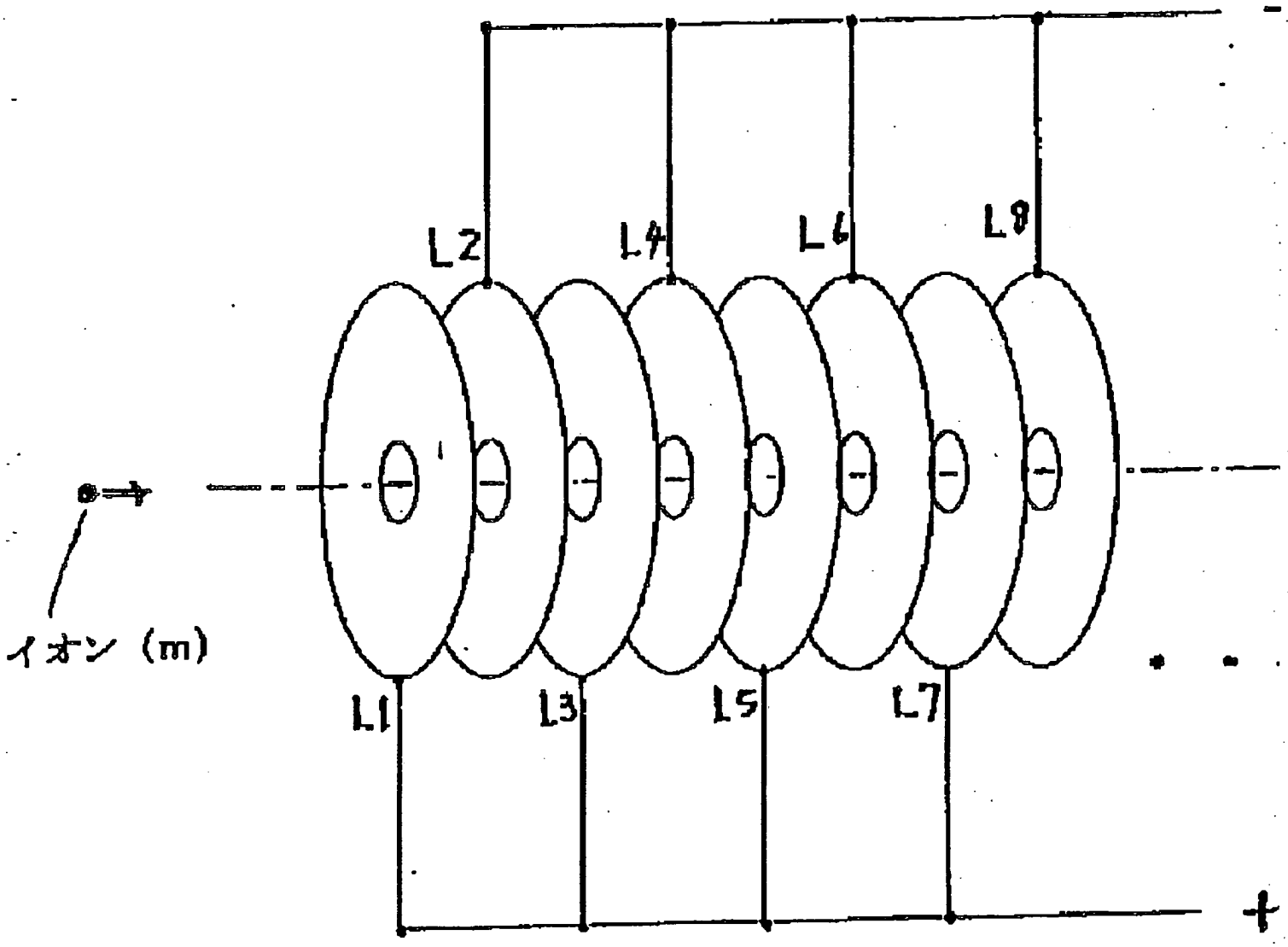
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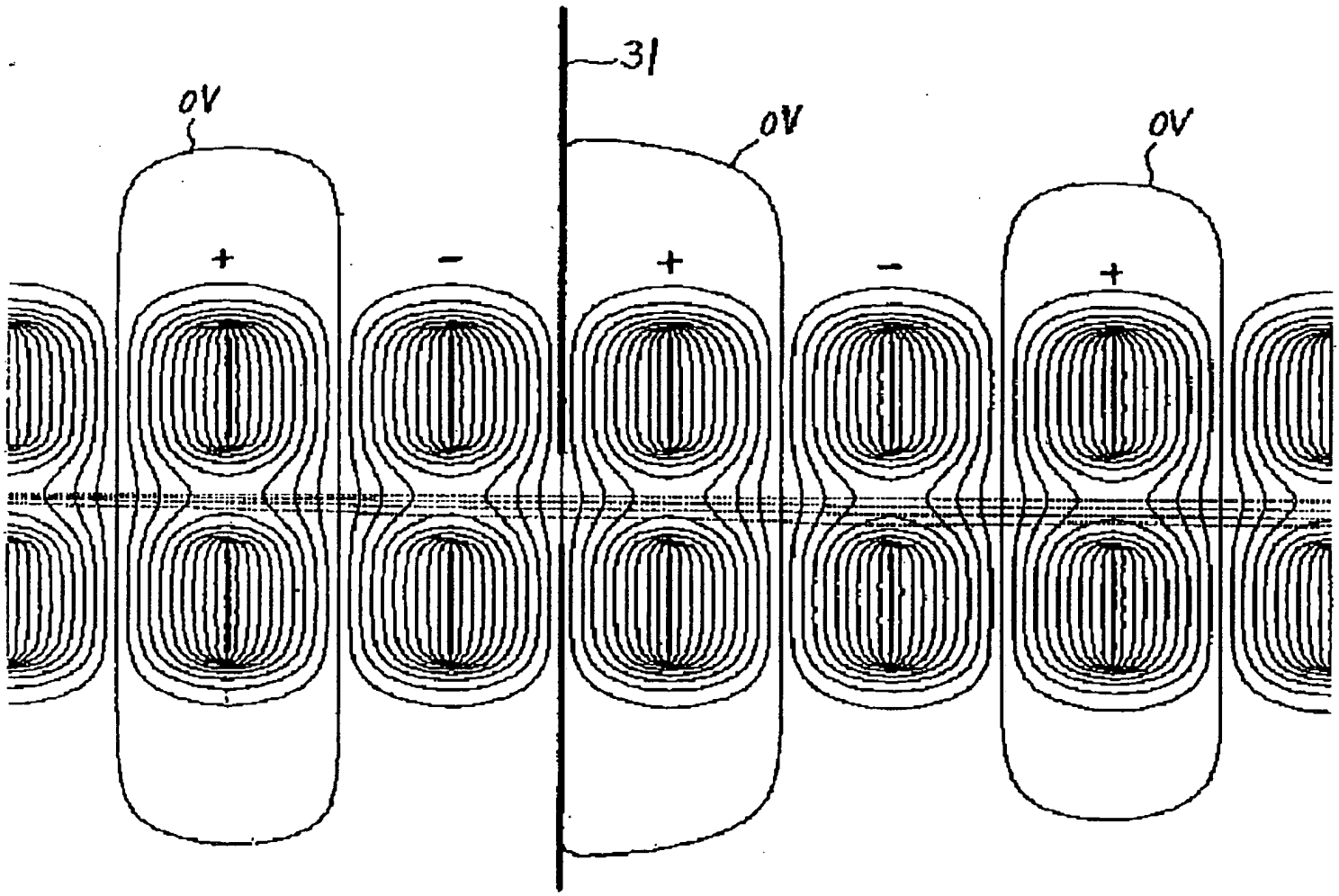
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ATMOSPHERIC PRESSURE IONISATION MASS SPECTROMETER

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(54) **[Title of the invention]** Atmospheric pressure ionisation mass spectrometer

(57) **[Abstract]**

[Problem] To provide an atmospheric pressure ionisation mass spectrometer capable of guiding ions generated by an atmospheric pressure ion source through an inlet into the intermediate evacuation chamber and on into the mass spectrometry unit over a broad range of different mass-to-charge ratios and with a high degree of efficiency.

[Means of solution] An atmospheric pressure ionisation mass spectrometer which ionises samples at atmospheric pressure or close to atmospheric pressure, guiding them through an inlet into a mass spectrometry unit located within a vacuum where they undergo mass spectrometry, having an ion guide 21 which guides ions entering through the inlet into the mass spectrometry unit, this ion guide having a plurality of plate-shaped electrodes arranged

in a single row with apertures aligned for the ions to pass through, the electrodes being impressed alternately with positive and negative voltage. Partway along this ion guide is a barrier 31 which partitions the chamber in which the mass spectrometry unit is located from that into which the ions are guided through the inlet.

[Claims]

[Claim 1] An atmospheric pressure ionisation mass spectrometer which ionises samples at atmospheric pressure or close to atmospheric pressure, guiding them through an inlet into a mass spectrometry unit located within a vacuum where they undergo mass spectrometry, characterised in that it has an ion guide which guides ions entering through the inlet into the mass spectrometry unit, this ion guide having a plurality of plate-shaped electrodes arranged in a single row with apertures aligned for the ions to pass through, the electrodes being impressed alternately with positive and negative voltage, and a barrier between electrodes partway along the ion guide which partitions the chamber in which the mass spectrometry unit is located from that into which the ions are guided through the inlet.

[Claim 2] An atmospheric pressure ionisation mass spectrometer as claimed in Claim 1, characterised in that the barrier is located in or near to the position where the amplitude of the ion trajectory is smallest

[Detailed description of the invention]

[0001]

[Field of industrial application] The present invention relates to an atmospheric pressure ionisation mass spectrometer which ionises samples at atmospheric pressure or close to atmospheric pressure, guiding them through an inlet into a mass spectrometry unit located within a vacuum where they undergo mass spectrometry, and in particular to an ion guide which guides ions entering through the inlet into the mass spectrometry unit.

[0002]

[Prior art] Atmospheric pressure ionisation is widely used for a variety of reason including simplicity of handling and soft ionisation, typical methods including atmospheric pressure chemical ionisation (APCI) and electrospray ionisation (ESI). In these and other methods, a differential pressure system is employed in order to guide the ions into the mass spectrometry unit, which is maintained in a state of high vacuum.

[0003] Fig. 1 is a diagram which illustrates the ion guide unit of a mass spectrometer with a differential evacuation system of this sort. In Fig. 1, 1 is an atmospheric pressure ion source, 2 are ions generated by the atmospheric pressure ion source, which are guided through a skimmer 3 into a first intermediate evacuation chamber 4, and thence through a skimmer 5 into a second intermediate evacuation chamber 6. In the second intermediate evacuation chamber 6 are located multipole lenses 7 and converging lenses 8 for the purpose of improving ion convergence. Having passed through these lenses and acquired improved convergence, the ions are guided through an inlet 9 into the mass spectrometry unit 10, which is maintained in a state of high vacuum (pressure of around 10^{-6} Torr).

[0004] The first intermediate evacuation chamber 4 is evacuated with the aid of a rotary pump RP to a pressure in the region of between one and several Torr, the second intermediate evacuation chamber 6 with the aid of a turbomolecular pump TMP to a pressure in the region of between 1×10^{-8} Torr, the whole constituting a differential evacuation system whereby the pressure difference between the atmospheric pressure of the ion source and the high vacuum of the mass spectrometry unit 10 is maintained.

[0005]

[Problem which the invention seeks to solve] The multipole lenses 7 are provided in order to prevent diffusion of the ions within the second intermediate evacuation chamber 6, and comprise for instance four bar electrodes arranged equidistantly at 90° intervals around the ion passage and impressed with only high-frequency voltage. There may sometimes be six or eight bar electrodes.

[0006] However, multipole lenses act as filters, which makes it impossible to pass ions with a broad range of different mass-to-charge ratios through at once. To achieve this it becomes necessary to sweep high-frequency voltage amplitude or high frequency, which is complex and inconvenient.

[0007] It is an object of the present invention, which is has been executed in consideration of the above points, to provide an atmospheric pressure ionisation mass spectrometer capable of guiding ions generated by an atmospheric pressure ion source through an inlet into the intermediate evacuation chamber and on into the mass spectrometry unit over a broad range of different mass-to-charge ratios and with a high degree of efficiency.

[0008]

[Means of solving the problem] With the aim of achieving the above object, the present invention is an atmospheric pressure ionisation mass spectrometer which ionises samples at atmospheric pressure or close to atmospheric pressure, guiding them through an inlet into a mass spectrometry unit located within a vacuum where they undergo mass spectrometry, characterised in that it has an ion guide which guides ions entering through the inlet into the mass spectrometry unit, this ion guide having a plurality of plate-shaped electrodes arranged in a single row with apertures aligned for the ions to pass through, the electrodes being impressed alternately with positive and negative voltage, and a barrier between electrodes partway along the ion guide which partitions the chamber in which the mass spectrometry unit is located from that into which the ions are guided through the inlet.

[0009]

[Embodiment] There follows, with reference to the drawings, a detailed description of the present invention. Fig. 2 is a diagram which illustrates the configuration of an embodiment of the present invention. In Fig. 2, 1 is an atmospheric pressure ion source generating ions 2, which are guided through a skimmer 3 into a first intermediate evacuation chamber 4, and thence through a skimmer 5 into a second intermediate evacuation chamber 6 and on into a third intermediate evacuation chamber 11. Straddling between the second intermediate evacuation chamber 6 and the third intermediate evacuation chamber 11 is an ion guide comprising ring lenses 21. Ions guided by this ion guide pass through converging lenses 8 in the direction of an inlet 9, then through the inlet 9 into the mass spectrometry unit 10, which is maintained in a state of high vacuum (pressure of around 10^{-6} Torr).

[0010] As may be seen from Fig. 3, the ring lenses 21 comprise ring electrodes L1, L2, L3 ...with the circular apertures through which the ions pass arranged at uniform intervals in a single row. The electrodes are impressed alternately with positive voltage (+ V) or negative voltage (- V). A dividing plate 31 (earth potential), which partitions the second intermediate evacuation chamber 6 and the third intermediate evacuation chamber 11, has an aperture for the ions to pass through which is concentric with those of the electrodes.

[0011] Fig. 4 is a diagram which illustrates the distribution of potential formed around the dividing plate and the ring electrodes in the vicinity thereof, from which it will be seen that

the dividing plate 31 is located so as to lie at zero potential along the equipotential surface between adjoining ring electrodes. Ions incident upon a ring lens 21 pass through the centre of the electric field formed within the ring electrode and through the ring lens.

[0012] The diameter of the aperture in the dividing plate 31 through which the ions pass may be determined as necessary in order to maintain the pressure difference between the second intermediate evacuation chamber 6 and the third intermediate evacuation chamber 11, but is smaller than the apertures in the ring electrodes. As Fig. 2 demonstrates, the dividing plate 31 is located in or near to the position where the amplitude of the ion trajectory is smallest as it is guided through the skimmer 5 into the second intermediate evacuation chamber 6.

[0013] This means that despite the presence of the dividing plate 31 the ions are able to pass through the aperture in it with minimal loss.

[0014] It is preferable that the dividing plate 31 be located in the most appropriate position in relation to the mean free path and maximum ion passage efficiency (position where the amplitude of the ion trajectory is smallest or almost smallest). It should be added that various types of electrostatic lens may be used as the converging lens 8.

[0015]

[Effect of the invention] As has been explained in detail, the fact that in the present invention an ion guide is provided which guides ions entering through the inlet into the mass spectrometry unit, this ion guide having a plurality of plate-shaped electrodes arranged in a single row with apertures aligned for the ions to pass through, the electrodes being impressed alternately with positive and negative voltage, together with a barrier between electrodes partway along the ion guide which partitions the chamber in which the mass spectrometry unit is located from that into which the ions are guided through the inlet allows ions generated by an atmospheric pressure ion source to be guided through the inlet into the intermediate evacuation chamber and on into the mass spectrometry unit over a broad range of different mass-to-charge ratios and with a high degree of efficiency.

[Brief description of the drawings]

Fig. 1 is a diagram illustrating the ion guide unit of a mass spectrometer with a differential evacuation system;

Fig. 2 is a diagram which illustrates the configuration of an embodiment of the present

invention;

Fig. 3 is a diagram which illustrates the configuration of the ring lenses; and

Fig. 4 is a diagram which illustrates the distribution of potential formed around the dividing plate and the ring electrodes in the vicinity thereof.

[Explanation of the codes]

1: Atmospheric pressure ion source

2: Ions

3, 5: Skimmers

4: First intermediate evacuation chamber

6: Second intermediate evacuation chamber

11: Third intermediate evacuation chamber

21: Ring lenses

31: Dividing plate

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Ｇ０１Ｎ　27/62		Ｇ０１Ｎ　27/62	Ｅ	
Ｈ０１Ｊ　49/06		Ｈ０１Ｊ　49/06		

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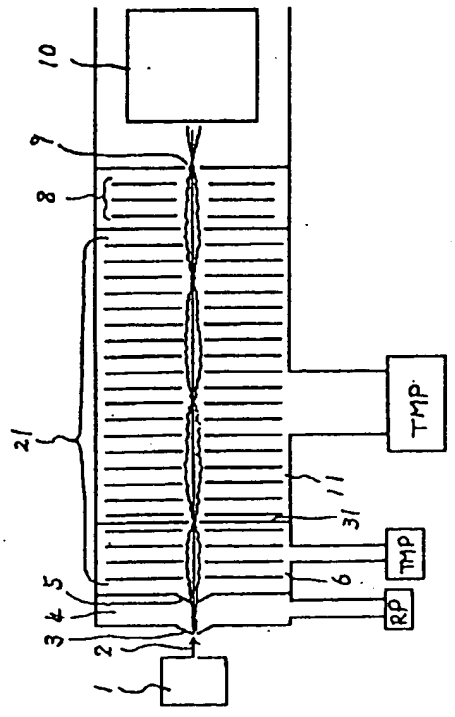
Ｆターム(参考)　5C038 FF07 GG08 GH11 GH13

(54)【発明の名称】　大気圧イオン化質量分析装置

(57)【要約】
【課題】　大気圧イオン源で生成され導入口を介して中間排気室に導入されたイオンを、広い質量範囲にわたり、高い通過効率で質量分析部へ導くことのできる大気圧イオン化質量分析装置を提供する。
【解決手段】大気圧又はその近傍の圧力雰囲気中で試料をイオン化し、真空中に配置された質量分析部へ導入口を介して導入し質量分析する大気圧イオン化質量分析装置において、導入口を介して導入されたイオンを前記質量分析部へ導くイオンガイドであって、イオン通過口を有する板状電極を多数通過口を合わせて一列に配置し各電極に交互に極性の異なる電圧を印加したイオンガイド２１を設ける。このイオンガイドの途中の電極と電極の間に質量分析部が配置される部屋と導入口を介してイオンが導入される部屋とを仕切る隔壁３１を設ける。



【特許請求の範囲】

【請求項１】　大気圧又はその近傍の圧力雰囲気中で試料をイオン化し、真空中に配置された質量分析部へ導入口を介して導入し質量分析する大気圧イオン化質量分析装置において、導入口を介して導入されたイオンを前記質量分析部へ導くイオンガイドであって、イオン通過口を有する板状電極を多数通過口を合わせて一列に配置し各電極に交互に極性の異なる電圧を印加したイオンガイドを設け、該イオンガイドの途中の電極と電極の間に質量分析部が配置される部屋と導入口を介してイオンが導入される部屋とを仕切る隔壁を設けたことを特徴とする大気圧イオン化質量分析装置．

【請求項２】　前記隔壁は、イオンガイド内におけるイオン軌道の振幅が最少又はそれに近い位置に配置されることを特徴とする請求項１記載の大気圧イオン化質量分析装置．

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、大気圧又はその近傍の圧力雰囲気中で試料をイオン化し、真空中に配置された質量分析部へ導入口を介して導入し質量分析する大気圧イオン化質量分析装置に関し、特に、導入口を介して導入されたイオンを前記質量分析部へ導くイオンガイドに関するものである．

【０００２】

【従来の技術】大気圧イオン化法は、取り扱いが容易であること、ソフトなイオン化であることなどから広く普及してきている．大気圧イオン化法の代表的なものには、ＡＰＣＩ（大気圧化学イオン化）法やＥＳＩ（エレクトロスプレイイオン化）法などがある．これらのイオン化法で生成されたイオンを、高真空に維持される質量分析部へ導入するために、差動排気系が用いられる．

【０００３】図１は、このような差動排気系を備えた質量分析装置のイオン導入部を示す図である．図１において、大気圧イオン源１で生成されたイオン２は、スキマー３を介して第１中間排気室４へ導入され、更にスキマー５を介して第２中間排気室６へ導入される．第２中間排気室６には、イオンの収束性を改善するためのマルチポールレンズ７及び収束レンズ８が配置されており、これらのレンズにより収束性の改善されたイオンは、導入口９を介して高真空（10^{-6}Torr程度の圧力）に維持された質量分析部１０へ導入されて質量分析される．

【０００４】前記第１中間排気室４は、ロータリーポンプＲＰにより１～数Torr程度の圧力に排気され、第２中間排気室６は、ターボ分子ポンプＴＭＰにより1×10^{-3}Torr程度の圧力に排気され、大気圧のイオン源１と高真空の質量分析部１０との間の圧力差が維持されるような差動排気系を構成している．

【０００５】

【発明が解決しようとする課題】上記マルチポールレンズ７は、第２中間排気室６におけるイオンの拡散を防ぐために設けられており、例えば４本の棒状電極をイオン通路の周りに９０°の等間隔に配置したQポールレンズに高周波電圧のみが印加される．６本あるいは８本の棒状電極を用いる場合もある．

【０００６】しかしながら、マルチポールレンズはフィルタ作用があり、質量電荷比の異なるイオンを広い範囲にわたって一度に通過させることができない．広い範囲に対応するためには、高周波電圧の振幅あるいは周波数を掃引することが必要で、これは構造が複雑となって不利となるし、感度の面でも不利である．

【０００７】本発明は、上述した点に鑑みてなされたものであり、大気圧イオン源で生成され導入口を介して中間排気室に導入されたイオンを、広い質量範囲にわたり、高い通過効率で質量分析部へ導くことのできる大気圧イオン化質量分析装置を提供することを目的とするものである．

【０００８】

【課題を解決するための手段】この目的を達成するため、本発明の大気圧イオン化質量分析装置は、大気圧又はその近傍の圧力雰囲気中で試料をイオン化し、真空中に配置された質量分析部へ導入口を介して導入し質量分析する大気圧イオン化質量分析装置において、導入口を介して導入されたイオンを前記質量分析部へ導くイオンガイドであって、イオン通過口を有する板状電極を多数通過口を合わせて一列に配置し各電極に交互に極性の異なる電圧を印加したイオンガイドを設け、該イオンガイドの途中の電極と電極の間に質量分析部が配置される部屋と導入口を介してイオンが導入される部屋とを仕切る隔壁を設けたことを特徴としている．

【０００９】

【発明の実施の形態】以下、図面を参照して本発明の実施の形態を詳説する．図２は本発明の一実施例の構造を示す図である．図２において、大気圧イオン源１で生成されたイオン２は、スキマー３を介して第１中間排気室４へ導入され、更にスキマー５を介して第２中間排気室６へ、更に第３中間排気室１１へと導入される．この第２中間排気室６及び第３中間排気室１１には、両者にまたがる形でリングレンズ２１から構成されるイオンガイドが配置されており、このイオンガイドにより導かれたイオンは、収束レンズ８により導入口９へ向けて収束されて導入口９を通過し、高真空（10^{-6}Torr程度の圧力）に維持された質量分析部１０へ導入されて質量分析される．

【００１０】上記リングレンズ２１は、図３に示すように、円形のイオン通過口を有するリング電極Ｌ1，Ｌ2，Ｌ3，・・・を、通過口を合わせて一定間隔で一列に並べた構造を有している．各電極には、１枚おきに正電圧（＋Ｖ）及び負電圧（－Ｖ）が交互に印加されている．前記第２中間排気室６と第３中間排気室７を仕切る仕切板３

1(アース電位)は、リング電極と同心のイオン通過口を有し、かつ隣り合うリング電極の中間の電位ゼロの等電位面に沿うように配置される。

【0011】図4は、仕切板31とその付近のリング電極の周囲に形成される電位分布を示しており、仕切板31が隣り合うリング電極の中間の電位ゼロの等電位面に沿うように配置されていることが分かる。リングレンズ21に入射したイオンは、リング電極内に形成される電界により中心軌道に沿って単振動を行い、リングレンズにガイドされる形でリングレンズを通過する。

【0012】前記仕切板31に設けられるイオン通過口の径は、第2中間排気室6と第3中間排気室7の間の圧力差を維持するために必要な大きさに選定されるが、リング電極のイオン通過口よりも小さい。そこで、仕切板31は、図2に示されているように、スキマー5を介して第2中間排気室6へ導かれたイオン軌道の振幅が最小又はそれに近い位置に配置されている。

【0013】そのため、イオンは、差動排気のための仕切板31が設けられていても、仕切板31のイオン通過口をロス少なく通過できる。

【0014】仕切板31は、軌道計算結果に従い、流入するイオンの平均自由行程とイオン通過効率(イオン軌道の振幅が最小又はそれに近い位置が高い)を考慮した最適位置に設定することが望ましい。なお、収束レンズ8としては、アインツェルレンズをはじめ、各種静電レンズを使用することができる。

【0015】

【発明の効果】以上詳述したごとく、本発明では、イオン通過口を有する板状電極を多数通過口を合わせて一列に配置し各電極に交互に極性の異なる電圧を印加したイオンガイドを設け、該イオンガイドの途中の電極と電極の間に質量分析部が配置される部屋と導入口を介してイオンが導入される部屋とを仕切る隔壁を設けたため、大気圧イオン源で生成され導入口を介して中間排気室に導入されたイオンを、広い質量範囲にわたり、高い通過効率で質量分析部へ導くことのできる大気圧イオン化質量分析装置が提供される。

【図面の簡単な説明】

【図1】差動排気系を備えた質量分析装置のイオン導入部を示す図である。

【図2】本発明の一実施例の構造を示す図である。

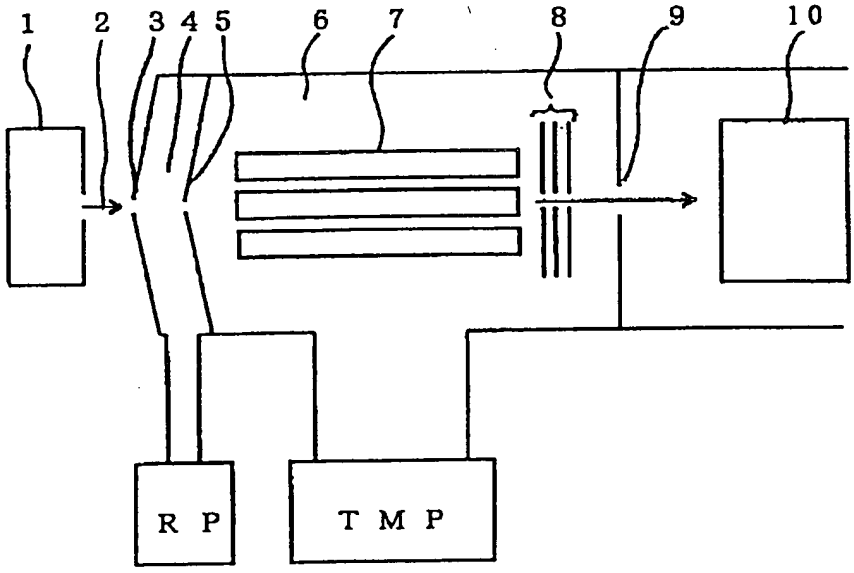
【図3】リングレンズの構造を示す図である。

【図4】仕切板とその付近のリング電極の周囲に形成される電位分布を示す図である。

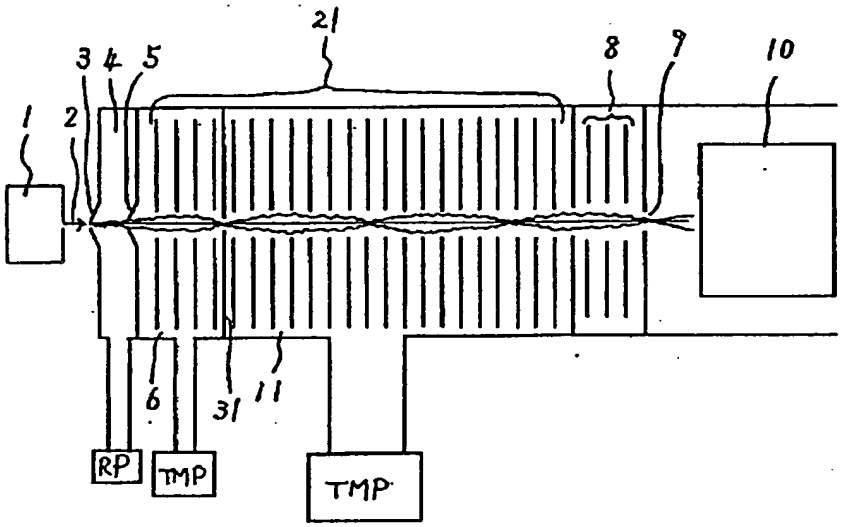
【符号の説明】

1：大気圧イオン源
2：イオン
3，5：スキマー
4：第1中間排気室
6：第2中間排気室
11：第3中間排気室
21：リングレンズ21
31：仕切板

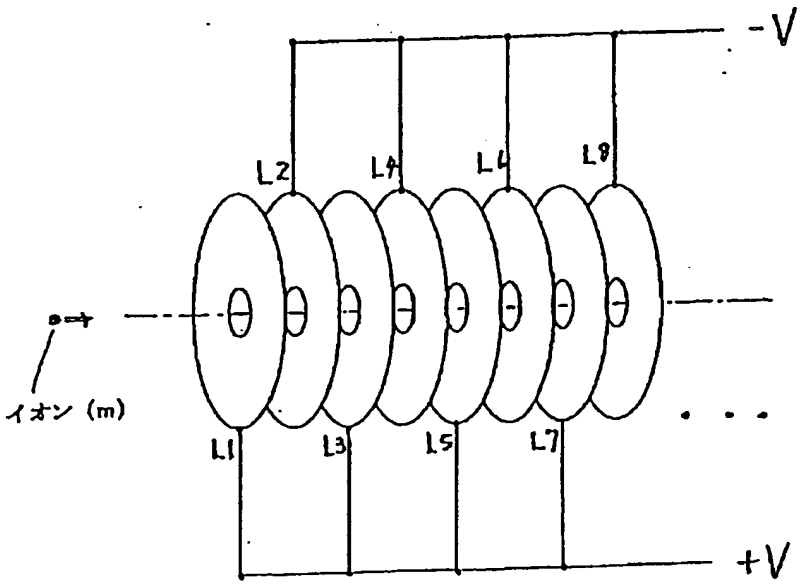
【図1】



【図2】



【図3】



【図4】